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ALBERT PÉRARD APPOINTED DIRECTOR OF INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES

The International Committee on Weights and Measures has announced the appointment of Albert Pérard as Director of the International Bureau of Weights and Measures, effective October 22. M. Pérard succeeds Dr. Charles-Edouard Guillaume, who has retired after serving in the Bureau for 53 years and as its Director since May 1915. The title of "Honorary Director" has been bestowed upon Dr. Guillaume.

M. Pérard has been attached to the International Bureau since 1905, and is widely known for his work on methods and instruments for precise measurement, particularly the measurement of lengths by means of wave lengths of light. More recently he has also had charge of the electrical measurements which constitute a new field of work for the International Bureau and has carried out precise comparisons of the electrical units as maintained in different countries. He was made Assistant Director of the Bureau in 1931.

IMPROVED ASTROGRAPHIC CAMERA

About 2 years ago a 9-inch astrographic camera lens was designed by I. C. Gardner, chief of the Optical Instruments Section, and last year this lens was constructed in the Bureau's optical shop from glass produced by the Bureau's glass plant. The lens, which is of the telephoto type, consists of four components grouped into two well separated doublets and was specially constructed for eclipse work. It was corrected for a field 20 inches square, corresponding approximately to 4.5 degrees.

A camera and mount for this lens were constructed of aluminum. In designing the mount the purpose was to make the complete equipment as light as possible for ease of transportation and to make the camera self-contained so that the focusing could be done in

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the laboratory before the equipment was packed for shipment. The plate-holder was driven by clockwork so as to follow the sun's image, the camera remaining stationary.

The National Geographic Society and the Bureau cooperated in sending Doctor and Mrs. Gardner with this apparatus to Ak Bulak, in western Siberia, where photographs were made during the total eclipse of June 19, 1936. Six satisfactory color films and two black and white negatives of the corona were made. On account of the excellent definition over the entire field, the outer corona can be traced to the extreme edges of the plates. The structure of the inner corona, particularly those lines indicating the presence of magnetic fields, is also faithfully recorded.

A more complete account of this achievement will appear in the February 1937 issue of the National Geographic Society magazine.

SELECTION OF COLORS FOR SIGNAL LIGHTS

At the request and with the financial support of the Bureau of Aeronautics, Navy Department, an investigation was undertaken by H. J. McNicholas at the Bureau to determine the best color limits for signal lights constituting a six-color system. The choice of suitable colors for any signal system is determined primarily by the number of colors required and the service conditions. In the present application the lights must be readily identified over a distance of approximately 1,500 feet, under weather conditions varying from a clear atmosphere to light haze. The signals are seen and identified as point sources of low intensity, and the colors are limited to those obtainable by combinations of an incandescent lamp and colored-glass cover globes.

Under these service conditions the problem is reduced to a choice between two six-color systems. One system consists of red, orange-yellow, white, green, blue, and purple. The other system consists of red, orange, yellow, white, green, and blue.

The best ranges of each color were determined and comparison made between the two systems. The work was done on an outdoor test range by groups of normal observers, under test conditions closely simulating those required in service. Various test colors were exhibited at different signal intensities in random order, and observers were asked to assign each color to one of the 6 permitted color classifications. In this way approximately 58,000 single observations were recorded in the selection of the colors and their tolerance limits.

As described in the December number of the Journal of Research (RP956), it was found that the orange and yellow were the least distinctive as signal colors when both are used with red and white. Permissible tolerances were also found to be too restricted for easy reproduction of the colored glassware. Furthermore, these orange and yellow colors are not stable with varying distance and appear shifted toward the red as the distance is decreased (higher signal intensity).

Considerable difficulty was experienced in the discrimination between green and blue and it was found that a highly saturated "sextant" green was required to gain the maximum distinctiveness from a saturated blue. At long distances (low signal intensities) a definite tendency to confuse the green and blue is unavoidable.

Purple, in general, is not a good long-distance signal color because of the low transmission of light by all purple-glass cover globes and the well-known dichromatic nature of this signal when seen as a very small source. This color proved to be very distinctive, however, when the signal intensity was made comparable with that of the other colors. This required a lamp intensity at least 21 times that required for white or yellow signals.

On the whole, the tests favor the selection of red, orange-yellow, white, green, blue, and purple as the best six-color signal system for the required service conditions.

ABSOLUTE DETERMINATION OF GRAVITY

The absolute determination of gravity at Washington, which has been carried on by Paul R. Heyl and G. S. Cook for the past 6 years, has been completed and the results will be published in the December Journal of Research (RP946). This is the first absolute precision determination that has been made anywhere in the world since that at Potsdam, Germany, published in 1906. Attention may be directed to a number of points of special interest in the present determination.

The work was done with three pendulums of fused silica, to eliminate temperature corrections as nearly as possible. In addition, the standard scale used to measure the lengths of the pendulums was also of fused silica.

Especial attention was given to the flexure correction, which arises from

the fact that a pendulum bends slightly as it swings. While this effect can be demonstrated to be present to a considerable extent in either the down or up position of a swinging pendulum, it was found experimentally to be partly eliminated in the reversal of the pendulum. (BS J. Research 8, 657 (1932) RP444.)

The factor causing the greatest variation in the results was found to be the knife-edge. Both the material of the knife-edge and the sharpness of its edge were found to be of importance. The material of the supporting plane, on the other hand, was of secondary importance.

The result obtained for the value of gravity at this station is 980.08 cm/sec.^{2} This value is less than that given by direct comparison with the station at Potsdam, Germany, by 2 parts in 100,000. A discussion of the probable cause of this difference is given.

PROPERTIES AND INDUSTRIAL USES OF SILVER

Silver is one of the few metals, the history of which can be traced back to the earliest days of antiquity. Its position in the field of industrially useful metals has recently become of increasing importance. This renewed interest in silver as an engineering material is a natural consequence of its rather remarkable physical properties. In several important respects silver stands at the head of the list of metals.

For many years silver has been a convenient material for physicists to use in their observations of the workings of physical laws, and much information has been accumulated in this way. The increasing interest in silver has created a demand for information on its physical properties, but, because these data were widely scattered in the technical literature, they were not readily available. Recently, through a cooperative arrangement with a group of eight of the leading silver producing companies of the United States, the Bureau was enabled to make a survey of the technical information on silver and assemble it into a conveniently usable form. Much additional information, hitherto unpublished, was obtained by visits to, or correspondence with, those interested in the use of silver.

The assembled information is being published as Circular C412, Silver: Its Properties and Industrial Uses. It is arranged in three parts. The first part deals with the physical, chemical, and technological properties of the pure metal. The second part presents the available data on a number of the commercially important alloys of silver with base metals. In the third part are discussed industrial uses of silver, in three groups: electrical, chemical, and bactericidal. A comprehensive bibliography citing the original sources of information is appended to each section of the Circular. Copies of this publication are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

OXIDE FILMS AS A PROTECTION AGAINST WEAR

The effect of oxygen-free atmospheres (nitrogen and hydrogen) upon the wear of a hypoeutectoid, a eutectoid, and a hypereutectoid carbon steel has been studied by S. J. Rosenberg of the Bureau's Metallurgical Division. It was found that when these steels were hardened and subsequently tempered at low temperatures, the rates of wear were comparatively low; the wearing surfaces were smooth and were covered by a thin oxide film, and the abraded particles consisted of Fe_2O_3 and Fe_3O_4. When these steels were tempered above certain temperatures, the rates of wear were extremely high; the worn surfaces were very rough and bright, and the abraded particles were metallic iron. When tested in air all steels were covered with an oxide film and the rates of wear were low.

FIELD TEST FOR STONE FLOOR TILE

The severe service conditions imposed on floors in the buildings of the United States Mint have shown that special care should be exercised in selecting materials for the floor surface. An acid-resistant material is necessary, as well as one that will not wear to an uneven surface.

In two new Mint buildings the Treasury Department has undertaken the unusual procedure of testing the wear resistance of every floor tile before setting it. In order to make such determinations on the job, it was necessary to have a simple testing device and a controlled method which could be applied without injury to the tiles. Such testing equipment as has been used for wear resistance determinations could not be adapted to such use, so the Treasury Department requested the Bureau to design an apparatus to meet the requirements.

In the search for a feasible method it was first assumed that an abrasive wheel could be adapted to the purpose.

A wheel 6 inches in diameter and 0.5 inch thick was tried by causing it to cut a groove in the tile under controlled conditions. The depth or length of cut for a given number of turns was taken as a measure of wear resistance. It was found, however, that an abrasive wheel could not be relied upon for constant cutting qualities because of clogging and dulling of the cutting edge. A steel wheel and a dry abrasive powder was substituted for the abrasive wheel. This gave encouraging results but considerable difficulty was experienced in finding a means of feeding the abrasive at a constant rate.

After numerous trials a satisfactory design was worked out. The floor tile is laid on an inclined table, the plane of the surface making an angle of about 40° with the horizontal. The wheel is mounted on a frame which is hinged on the drive shaft. Dry abrasive from a funnel mounted on the frame is fed at a controlled rate on a small belt conveyor and is led through an inclined trough to the cutting edge of the wheel. The pressure of the wheel on the tile is caused by the weight of the mechanism supported by the tile.

The length of cut for 25 turns of the wheel is determined. The test is applied to the back surface of the tile and hence no damage results.

As the specifications for the floor tile required an abrasive hardness of H_a not less than 15 nor greater than 20 it was necessary to determine the relation between results obtained with the field apparatus and those obtained with the usual laboratory apparatus. It was found that the two testing devices agreed very well for the range of hardness values ordinarily met with in floor tile, but for very hard materials the results with the field apparatus were rather uncertain.

GLASS PHASE IN HEATED CLAY MATERIALS

Two methods of approach are being employed in the study of the nature of the glass phase in heated clay materials. Since it is impossible mechanically to separate the glass bond present in heated clay materials, one method of studying glassy phase is the petrographic examination of bodies themselves, the object being to determine the relationship between the glassy reaction products of the body ingredients and the properties of the bodies. At the other extreme, the study of homogeneous synthetic glasses constitutes the second method of attacking this problem. The composition of these synthetic glasses was limited to three or four oxides in order to correlate their physical properties and chemical compositions. The range of composition was sufficient to include many glasses undoubtedly present in various commercial products. A total of 80 synthetic glasses were tested, 65 of which were in the 4-component system $K_2O.CaO.Al_2O_3.SiO_2$ and 15 in the 3-component system $K_2O.Al_2O_3.SiO_2$. The glasses were prepared by fusion of pure silica, hydrated alumina, and calcium and potassium carbonates. Determinations of critical and softening temperatures were made on all of these glasses. Their total expansions were also determined in the following temperature intervals: 25 to 500° C., 25° C. to critical temperature, and 25° C. to softening temperature. The results showed that the K_2O content had the greatest effect on their expansions. The least effect was produced by the SiO_2 and the Al_2O_3 content, the two being about equal. The effect of CaO on expansion was intermediate between those of K_2O and SiO_2. Glasses of constant expansion but varying widely in chemical composition were found.

DIFFERENCES IN LIMES AS REFLECTED IN CERTAIN PROPERTIES OF CEMENT MORTARS

Lime is often added to cement mortars to improve their working properties. Usually more attention is paid to the proportions of the mix than to the properties of the lime and the manner in which it is used. Consequently, an investigation of certain properties of lime putties in relation to the resultant properties of lime and cement-lime mortars made from them was undertaken in the Bureau's lime and gypsum section.

The effect of the time of soaking on the soundness of lime putties was also investigated. It was found that out of 43 limes tested by the autoclave method, 7 of 24 hydrated limes and 8 of 19 pulverized quicklimes gave putties which were classified as unsound at the end of 1 day of soaking. At the end of 3 days of soaking, four putties from the hydrated limes and four from the quicklimes were unsound.

The plasticity values of the putties determined with the Emley plasticimeter, varied from 50 to more than 600. Putties of widely varying plasticity were then used in preparing lime-sand mortars (1 part lime to 3 parts sand by weight) and adjusted to a flow of 130 percent as measured on a standard

10-inch flow table. The flow was again determined after 1 minute of suction (equivalent to a head of 2 inches of mercury) had been applied by means of a suction device designed to remove water from the mortar much as is done by a porous body. The flow after suction varied from 73 to 117 percent. In general, the flow after suction is dependent to a considerable extent on the plasticity of the putty used in preparing the mortar. This also proved to be true after a suction period of 10 minutes.

Cement-lime mortars of varying proportions were also prepared using lime putties of varying plasticity and cements of medium and high specific surface. The mortars were brought to an initial flow of 130 percent and the flow again determined after 1 minute of suction. The results showed that the higher flows after suction were obtained with the more plastic limes and that the kind of lime used is of more importance than the proportions in securing a high flow after suction. Furthermore, limes made into putties produced mortars of higher flows after suction than did hydrated limes not soaked as putties. The substitution of the proper lime putty for cement produced higher flows after suction than could be obtained by the use of a cement of high specific surface.

The complete report of this work will be found in the Journal of Research for December (RP952 by Lansing S. Wells, Dana L. Bishop, and D. Watstein).

BOILING POINTS OF ORDINARY AND HEAVY WATER

The differences between the boiling points of dilute aqueous solutions of heavy water and the boiling point of ordinary water were measured by Edgar R. Smith and Mieczysław Wojciechowski in the range from 0.3 to 7 percent of heavy water (deuterium oxide). The boiling points were found to increase linearly with increase in D_2O, according to the equation—

$$\text{mole\% } D_2O = 70.9\ (\Delta T),$$

where ΔT is the boiling point in degrees centigrade, minus 100. The measurements, made with ebulliometers of the type devised by W. Swietoslawski, were found to offer a rapid method for the analysis of solutions of heavy water.

The differences between the boiling points and condensation temperatures of the same solutions were measured in a differential ebulliometer which gave a fractionation equivalent to about one theoretical plate. The small separation between the vapor and liquid lines on the boiling point-composition diagram shows that the separation of heavy water by fractional distillation would require columns of extreme efficiency. For a more complete account of this work, RP947 in the December number of the Journal of Research should be consulted.

EXTRACTION OF CONSTANT-BOILING FRACTIONS OF A "WATER-WHITE" LUBRICATING OIL

RP953, by Beveridge J. Mair and Sylvester T. Schicktanz in the December Journal of Research, describes a continuation of the work on the chemical constitution of the lubricating oil fraction of petroleum undertaken at the Bureau as part of American Petroleum Institute Research Project 6. In particular, it describes the separation, with respect to type of molecule, effected by solvent extraction of substantially constant-boiling fractions of a "water-white" lubricating oil. Each charge of about 500 grams was separated, by extraction with acetone in 14-meter columns, into from 25 to 35 fractions. In these extractor columns the oil globules and acetone flowed countercurrently. The columns were operated in a manner analogous to fractional distillation under total reflux, in which the acetone saturated with oil corresponded to the vapor phase and the oil globules to the liquid reflux. Kinematic viscosities at 37.7° C. (100° F.) and 99° C. (210° F.) and refractive indexes of all fractions from the extractors were determined. In addition carbon-hydrogen ratios, molecular weights, densities, dispersions, optical activities, boiling points, and aniline points of about 30 "key" fractions were determined. The wide spread in these physical properties shows that an excellent separation with respect to type was obtained.

PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION OF LUBRICATING OIL FRACTIONS

A considerable divergence of opinion exists concerning the chemical constitution of the higher boiling fractions of petroleum. An investigation of this question by Beveridge J. Mair and Charles B. Willingham at the Bureau in cooperation with the American Petroleum Institute, is described in the Journal of Research for December (RP954). In this work the properties

of extensively distilled and extracted fractions of lubricating oil have been correlated and compared with the properties of synthetic hydrocarbons of high molecular weight. The results show that the least soluble portion of the oil (the material corresponding to the most highly refined product obtained by any good solvent extraction process) consists substantially of naphthenes (cycloparaffins) containing from one to about three rings to the molecule, together with the necessary alkyl radicals. The somewhat more soluble portion consists of naphthenes with more rings, together with some unsaturated hydrocarbons and possibly some aromatic hydrocarbons. There is no evidence whatever for the presence of iso or branched-chain paraffins.

Because of the similar solubility relations, it is possible that in the extraction processes as used at the present time one-ring aromatic hydrocarbons are being discarded to waste along with the undesirable naphthenes containing about six rings to the molecule. This is a point well worth investigating since these one-ring aromatic hydrocarbons may be a valuable constituent for good lubricating oil.

ISOLATION OF AN ISONONANE FROM PETROLEUM

A nonane boiling at 135.2° C. (probably a dimethylheptane) has been isolated from petroleum for the first time by Joseph D. White and F. W. Rose, Jr. This has been accomplished solely by physical means. The work is part of an investigation, in progress at the Bureau under the sponsorship of the American Petroleum Institute, on the separation, identification, and determination of the constituents of petroleum.

The compound was found closely associated with a naphthenic hydrocarbon in the fraction of an Oklahoma petroleum which distilled chiefly at 136° C. after the aromatic hydrocarbons present had been removed. It constitutes about 0.1 percent of the crude oil.

Extended distillation in the usual way partially separated the mixture but it also resulted in pronounced thermal decomposition of the still residues which were enriched in the naphthene. This compound, however, was successfully removed without decomposition, by distilling the mixture with glacial acetic acid, a method suggested by S. T. Schicktanz. The method had the further advantage of permitting smaller quantities of oil to be distilled, and of removing small amounts of aromatic hydrocarbons which remained in the mixture. An attempt to crystallize the residual paraffin concentrate was unsuccessful. On cooling, it became suddenly viscous at —115° C. and would not form crystals. Hence, in order to separate the nonane in a nearly pure condition, it was necessary to crystallize the material from a solution in a solvent of low viscosity. The solvent used was liquid dichlorodifluoromethane.

The isolated nonane is one of 35 isomeric hydrocarbons having the formula C_9H_{20}, many of which have never been prepared. Consequently it is not possible to say with certainty which isomer the compound from petroleum may be. Its physical properties, including boiling point, freezing point, density, refractive index, optical activity, and critical solution temperature in aniline, have been determined. Of the known nonanes, the properties of 2, 6-dimethylheptane are most similar to those of the isolated compound. For this reason the two substances may be the same, but it is quite possible that the nonane from petroleum has not yet been synthesized.

A full account of this work will be found in the Journal of Research for December (RP955).

PHYSICAL PROPERTIES OF ISOPRENE

The relation between isoprene and rubber is being studied by Norman Bekkedahl, Lawrence A. Wood, and Mieczyslaw Wojciechowski at the Bureau. It has long been known that natural rubber when heated to an elevated temperature yields isoprene, and conversely that isoprene under other conditions polymerizes to form a synthetic rubber. A clear understanding of this apparently reversible reaction can best be gained from a consideration of the free energies and other thermodynamic properties of the rubber and the isoprene. Thermodynamic measurements on rubber were reported in J. Research NBS 15, 503 (1935) RP844, and similar measurements on isoprene are now in progress.

This work requires that isoprene be prepared in a state of high purity. Inasmuch as there is considerable variation among the values of the physical properties of isoprene as reported by different observers, it has seemed worth-while to make careful determinations of these values on freshly purified samples. The results of this work are reported in RP951 in the Journal of Research for December, and may be summarized as follows: Normal boiling point, 34.076 ±0.003° C.; change of boiling point with change of pressure, 0.0383 ±0.0001° C/mm of

Hg; freezing point, —146.8 ±0.2° C.; density at 20° C., 0.6805 ±0.0001 g/ml; refractive index at 20° C., 1.42160 ±0.00005. The volume coefficient of expansion was measured from the freezing point to the normal boiling point, with results expressed by the following equations:

$$V=V_0\ (1+1.393\times10^{-3}t+2.79\times10^{-6}t^2 +4.31\times10^{-9}t^3-5.60\times10^{-12}t^4$$

$$\rho=0.7002-0.9754\times10^{-3}t-0.592\times10^{-6}t^2 +0.525\times10^{-9}t^3+9.66\times10^{-12}t^4$$

in which V and ρ are the volume and density, respectively, at the temperature t, and V_0 is the volume at 0° C. From the Clausius-Clapeyron equation the latent heat of vaporization at the normal boiling point was calculated to be 25.8 ±0.3 kj/mole (6.17 ±0.07 kcal/mole). The refractive index at any temperature t from about 0° C. to the boiling point may be calculated from the equation $n_D=1.43472-0.0656\times10^{-3}t$. The isoprene was found on standing to undergo a transformation, presumably oxidation and polymerization, as was indicated by an increased difference between boiling and condensation temperatures and also by changes in boiling point, density, and refractive index.

It is anticipated that this work on isoprene may be of interest in fields other than that of rubber, since there is evidence that isoprene is an intermediate product in the formation of terpenes in nature, and also that it may play an important role in the formation of plant cells.

THE NATIONAL BUREAU OF STANDARDS AND THE PLASTICS INDUSTRY

The materials which are used in modern plastics have been and are continuing to be developed on the basis of chemical studies in technical laboratories. These developments have been described and exhibited many times as an outstanding feat of modern science. Certainly the manufacture of some of these colorful plastics entirely from gases in the atmosphere is an achievement to stir the imagination. The production of synthetic ammonia from nitrogen and hydrogen and its conversion into urea by reaction with carbon dioxide, are well-established processes in the chemical industry. Likewise formaldehyde is synthesized commercially by the reaction of carbon monoxide and hydrogen to yield methyl alcohol which is subsequently oxidized catalytically to the aldehyde. These two synthetic products, urea and formaldehyde, are then converted into a modern heat-hardenable plastic by interreacting chemically. Similar seemingly impossible changes of state could be described for the whole gamut of synthetic plastics. Likewise the fabrication of these plastics into molded products is a technical problem involving a combination of mechanical skill and a knowledge of engineering principles. Plastics were formerly considered materials suitable only for making small parts which were required in large numbers. The development of larger capacity presses has, however, shown that housings and cabinets of considerable size and for which there is relatively limited demand can be advantageously molded of synthetic resins because of their light weight, resistance to corrosion, and handsome appearance. Similarly, the injection molding press is a recent technical development which is expanding the possible markets for plastics and is necessarily of interest to every molding plant.

The more the public knows about a product, the way in which it is manufactured, and the work that is being carried on to improve it and to extend its applications, the greater is their interest and confidence in that product and its manufacturer. Some companies have pursued a liberal policy in the publication of such studies without apparent harm to themselves and certainly with an enhancement of prestige. Plastics have unquestionably caught the public's fancy, but this popular interest can be maintained only by continued activity in the laboratory. People are not so much interested in a particular application of a material, as they are in the way in which the product is made and the advantages which it offers for a given application. An ashtray is an ashtray whether it be of ceramic, metal, or organic plastic composition, but if it was synthesized from ingredients originally derived from such diversified sources as coal, water, salt, and a farmer's field, it becomes a topic of conversation. The desire of the public for technical facts regarding both materials and processes is evidenced by the establishment of private organizations to supply this information to consumers, by the increasing amount of space given to technical information in newspapers, and to the establishment of many permanent exhibit centers. It is the responsibility and also the opportunity of the manufacturers to build up this interest by the release of technical information pertaining to their materials.

The plastics section of the Bureau was organized a little more than 1 year ago. Thus far, its experimental work has been largely centered upon transparent plastics for aircraft windshields, but the section has been called upon many times both by Government departments and by private firms and individuals for recommendations covering materials for a wide variety of applications. One problem which is causing much concern at the present time is to find a bird proof windshield for transport airliners. There have been reports of birds smashing through the windshields and in some cases stunning the pilot or disabling him with flying glass. If the average combined speed of the airplane and bird is 270 miles per hour and the bird weighs about 4 pounds, an energy of approximately 10,000 foot-pounds is involved in the impact. Drop tests in the Washington Monument were considered until second thought revealed that it would be necessary to drop a 20-pound weight down the 500-foot shaft to get a 10,000 foot-pound impact. For theoretical reasons it is also necessary to keep the mass and velocity conditions more nearly like those to be encountered.

Another problem brought to the Bureau's attention is the matter of coffee cups for prison dining rooms. The usual heavy china cup or "mug" in the first place, does not stand up well under the rough dishwashing treatment to which it is subjected and, in the second place, is capable of serving as a dangerous weapon. The prison authorities are looking toward the lighter and more resilient plastics.

A subject which has been suggested to the Bureau by several members of the industry as meriting immediate attention is the matter of test methods for plastics. This is a branch of scientific endeavor in which the Bureau has made many contributions in other fields. There is no doubt that despite the notable work of Committee D–9 of the American Society for Testing Materials in establishing standard procedures for testing insulating materials, there exists considerable nonuniformity and confusion in many of the tests not considered by this group. At present there is considerable difficulty in obtaining reliable comparisons based on results in different laboratories. Furthermore, there is a real need for more data on the properties of plastics. If the plastics industry were organized into an association similar to those existing in the rubber, textile, paper, and leather industries, it would be an easy matter to proceed with a standardization program in the matter of tests. In fact, this has been one of the first problems which these trade associations have tried to solve. The Bureau hopes to obtain the active cooperation of the industry in its work, to the end that real progress may be made toward providing better and more uniform data on the properties of plastics.

STABILITY OF MOTION-PICTURE FILMS

Motion-picture film of the safety type shows great promise as material on which to preserve records of permanent value, according to tests made by John R. Hill and Charles G. Weber of the Bureau's Paper Section, and reported in the Journal of Research for December (RP950). This type of film, which has a base of cellulose acetate, is designed for use where the highly combustible film of the ordinary theater type, the base of which is cellulose nitrate, presents too great a hazard from fire and explosion. In addition to its safety features, it appears to have the additional advantage of being much more lasting. Both types of film were studied by determining the effects of various accelerated aging treatments on samples of new film. Samples of old nitrate film were tested also to ascertain their condition after natural aging.

The most satisfactory accelerated aging treatment was found to be that employed in determining the relative stability of record papers. This treatment consists in heating the film in a dry oven, at 100° C. The physical and chemical properties of the films were determined before and after oven-aging tests of various durations, and changes in the properties noted. High retention of folding endurance and viscosity and small increase in acidity are considered indicative of stability. The acetate film was found to be excellent in these respects. Large losses in folding endurance and viscosity, and large increases in free acid in the material characterized the changes in nitrate film under the heat test. Its poor stability was further indicated by rapid decrease in resistance to a stability test used to determine the condition of smokeless powder.

The cellulose acetate film withstood oven-aging for 120 days without serious chemical or physical deterioration, while the nitrate film became useless after 10 days under the same conditions. The acetate appears to have lasting qualities comparable to those of permanent record papers of high quality, and the optimum atmospheric con-

ditions for the preservation of paper records are likewise suitable for this film. Nitrate film is perishable and its deterioration is greatly accelerated under warm, moist conditions. The preservation of valuable nitrate film is a complicated problem involving both elaborate fire protective measures and air conditioning.

EFFECT OF FIBER COMPONENTS ON STABILITY OF BOOK PAPERS

Through many experiments, the Bureau has shown that relatively permanent book papers can be made from a number of the papermaking fibers in common use today.

The suitability of book papers for temporary use is evident, but their life expectancy is not so apparent. As to the longevity required, book papers range from papers for permanent records to those for current use only. The initial cellulosic purity of the papers, as well as conditions of use and storage, influences their resistance to reactions that induce deterioration. In the Bureau's Paper Section, Merle B. Shaw and Martin J. O'Leary are studying the relation of papermaking materials and processes to the stability of book papers. The study includes the effects of the components of fibers commonly used in fine printing papers, of filling and sizing materials, and of mineral coating materials. Unsized experimental papers have been made from a number of commercial wood pulp and rag book-paper fibers. The fibers were chosen primarily to have them representative of the cellulosic purity found in the average current commercial products. The pulps and resultant papers were given extensive chemical and physical tests with particular reference to stability. In this work consideration was given to the fiber components, alpha, beta, and gamma cellulose and pentosans. The degree of retention of the initial strength and desirable chemical properties of the paper was also determined after an accelerated aging test made by heating the paper for 72 hours at 100° C.

The changes in the beta and gamma cellulose content of the heat-treated papers were not significant enough to warrant the use of these values as criteria of the stability of the papers. The present belief that alpha-cellulose content and copper number are closely related to stability of paper and that high alpha-cellulose content and low copper number, with very little change in these attributes when papers are heated, are characteristics of stable paper, is supported by the data. Using as an index of life expectancy the chemical purity of the papers and their stability in the heat test, close relation was shown between the cellulosic purity of the pulps and the stability of the experimental unsized book papers produced from them. The stability of papers made from the same pulps when filling and sizing variables are introduced in their manufacture remains to be determined in a subsequent part of the investigation.

While the main object of the study (which is an extension of previous similar work on writing papers) is to assist paper manufacturers and users in the classification of book papers with respect to their endurance, the data should be of value to anyone interested in the preservation of valuable records. RP949 in the December number of the Journal of Research should be consulted for a more complete account of the work.

SIMPLIFICATION OF SIZES OF PHOTOGRAPHIC FILM FOR COPYING RECORDS

Simplified Practice Recommendation R165–36, Photographic Film for Miniature Copies of Records, effective from August 1, 1936, is concerned with the widths of film used in copying all forms of documentary material, either as a preservation measure or to make it more accessible. The purpose of the recommendation, which establishes 16- and 35-mm motion-picture film as the stock sizes for use in copying, is to aid in stabilizing the growth of what may be termed a new industry.

Students and others interested have found that, under conditions imposed by travel in many countries, "movie" films are readily available and easily adapted to their needs. Photographic copies so made have been variously described as "microcopies", "film slides", "filmstats", etc.

Users state that among the advantages offered by this method of copying records are: Possibility of reproducing great blocks of material at relatively low cost; ease of preservation of data; and expedition of interlibrary loans.

The importance of establishing specific widths of film is evident when attention is directed to the fact that apparatus to supplement the camera itself must be designed to permit direct reading from either the finished negative or a film positive thereof and to make possible satisfactory projection of the positive upon a suitable screen or an en-

largement of the recorded image upon paper as a permanent positive print.

It is believed by some workers in this field that certain types of copying cannot be accomplished adequately on areas of film that are smaller than that made possible by the 70 mm size. However, this Simplified Practice Recommendation is concerned primarily with film that is produced for stock, in anticipation of known demand. Therefore, the use of 70-mm film is not precluded when that size is required to fill a special need. If the 70 mm width finds increased usage the demand will be recognized by the film manufacturers. At that time also the Simplified Practice Recommendation can be revised to bring it abreast of existing best practice.

Until the printed book is available, free mimeographed copies of the recommendation can be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

The printed edition of the recommendation will contain, in addition to the film widths, a brief history of the project, and a list of organizations and firms which have accepted the program.

SIMPLIFICATION OF SIZES OF BED BLANKETS

Simplified Practice Recommendation R11–36, Bed Blanket Sizes (Cotton, Wool, and Cotton and Wool Mixed) is the first revision of this recommendation, which was adopted in 1924 by a general conference of representatives of manufacturers, distributors, and users. The recommendation became effective November 1, 1924, and in its original form established a simplified schedule of 12 sizes of bed blankets, ranging from 54 to 76 inches to 80 by 90 inches. It was reaffirmed without change in 1930 and 1932.

The simplification of types and sizes of beds, springs, and mattresses attracted the attention of the bed-blanket industry and suggested the possibility of applying simplification to their product. Upon invitation, a representative of the Division of Simplified Practice attended the annual convention of wool-blanket manufacturers in 1922, at which time the fact was established that simplification of blanket sizes was clearly desirable. The advisability of conducting a survey of existing diversity of sizes was discussed. At a preliminary conference of manufacturers, distributors, and users of bed blankets, held in Washington in 1923, a simplified practice committee was appointed to make such a survey.

The returns disclosed the fact that during the 3 years, 1920 to 1922, 75.62 percent of the wool and wool-mixed bed blankets produced covered only 4 sizes, with less than 2 percent spread over 14 sizes, and that 80.12 percent of cotton blankets produced was concentrated upon only 7 sizes.

The results of this study were placed before a general conference of all interests, held at the Department of Commerce on February 1, 1924. The conference adopted the dimensions recommended by the committee, thus accomplishing a reduction from 78 to 12 sizes, or an elimination of 84.6 percent.

A further reduction to 11 sizes has been achieved through the changes incorporated in the current revision of the recommendation. These changes, which were proposed by the chairman of the standing committee in November 1935, consist of the elimination of sizes 64 by 76 inches and 68 by 80 inches from the simplified list, and the addition of a 66- by 76-inch size, in order to bring the program into line with existing practice in the industry. Upon concurrence by all members of the standing committee, the revision was circulated to the industry for acceptance, and on August 7, 1936, the Bureau announced that sufficient support had been accorded this program to warrant its promulgation and publication. The revised recommendation became effective on September 15, 1936.

Until printed copies are available, complimentary copies of the revision in mimeographed form can be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

ERRORS IN TECHNICAL NEWS BULLETIN

The following errors in Technical News Bulletin 235 (November 1936) should be corrected:

On page 99, second column, second line, "glycerol" should be "glycol."

On page 102, second column, eleventh line, "±0.6" should be "±0.06."

On page 104, first column, tenth line from bottom, "$_{20}a_{68}$" should read "$_{20}a_{80}$."

On page 105, first column, the line between the sixth and seventh lines from the bottom has been left out. This should read "by reducing thermal expansion, it in- ***."

NEW AND REVISED PUBLICATIONS ISSUED DURING NOVEMBER 1936

Journal of Research[1]

Journal of Research of the National Bureau of Standards, volume 17, no. 5, November 1936 (RP933 to RP945, inclusive). Price, 25 cents. Obtainable by subscription.

Research Papers[1]

[Reprints from the August 1936 Journal of Research]

RP910. Distribution of compounds in portland cement. J. Arthur Swenson and E. P. Flint. Price, 5 cents.

RP912. Load distribution and strength of elevator cable equalizers. Ambrose H. Stang and Leroy R. Sweetman. Price, 5 cents.

Circulars[1]

C412. Silver: Its properties and industrial uses. B. A. Rogers, Irl C. Schoonover, and Louis Jordan. Price, 10 cents.

Commercial Standards[1]

CS21–36. Interchangeable ground-glass joints, stopcocks, and stoppers. (Supersedes CS21–34.) Price, 5 cents.

Technical News Bulletin[1]

Technical News Bulletin 235, November 1936. Price, 5 cents. Obtainable by subscription.

MIMEOGRAPHED MATERIAL

Letter Circulars

Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards, and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or to send copies automatically as issued.

LC478. List of published material relating to paint, painting, varnish, lacquer, bitumens, and allied subjects.

LC479. Sources of information on the properties of metals and alloys. (Supersedes LC257.)

LC480. Tests for nonmetallic protective coatings for underground pipes.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents and $3.25, respectively.

RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS[2]

Some economic aspects of weights and measures supervision. Ralph W. Smith. Michigan Sealers' Bulletin (140 S. Jackson St., Jackson, Mich.) 9, No. 5, 1 (October 1936).

Should "not go" thread gages be truncated? H. W. Bearce. Am. Machinist (330 W. 42d St., New York, N. Y.) 80, 928 (November 4, 1936).

The new NBS ridemeter. H. C. Dickinson. Instruments (1117 Wolfendale St., Pittsburgh, Pa.) 9, 277 (October 1936).

An electric motor for radiometeorographs. L. F. Curtiss and A. V. Astin. Rev. Scientific Instruments (Cornell University, Ithaca, N. Y.) 7, 358 (September 1936).

Forceps for handing radioactive substances. L. F. Curtiss. Rev. Scientific Instruments (Cornell University, Ithaca, N. Y.) 7, 393 (October 1936).

The chemical constituents of lubricating oil. Frederick D. Rossini. Proc. Am. Petroleum Inst. (250 Park Ave., New York, N. Y.) 17, III (1936).

Carbon-monoxide indicators for aircraft. S. H. J. Womack and J. B. Peterson. Instruments (1117 Wolfdale St., Pittsburgh, Pa.) 9, 283 (October 1936).

Some electrometric pH equipment and hysteresis of calomel electrodes. Baker Wingfield and S. F. Acree. J. Am. Leather Chemists Assn. (Ridgway, Pa.) 31, 403 (October 1936).

Methods of testing plastics. G. M. Kline and B. M. Axilrod. Ind. Eng. Chem. (Mills Bldg., Washington, D. C.) 28, 1170 (October 1936).

Construction materials for low cost housing. A. S. McAllister. The Pennsylvania State College Bulletin (State College, Pa.) 30, 94 (September 1936).

[2] These publications are not obtainable from the Government. Requests should be sent direct to the publishers.

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